Meeting Conservation and Compliance Needs Through Improved Greater Sage-Grouse Lek Line-of-Sight Visibility Analysis Using Highest-Hit LiDAR Data

Project # 15-800

Background:

Across the western United States, successful management of greater sage-grouse (*Centrocercus urophasianus*) on Department of Defense lands involves balancing habitat protection and competing human-centered land uses. Habitat protections typically preclude development that is visible from sage-grouse breeding display grounds, known as leks, limiting the military's ability to operate in areas within and adjacent to sage-grouse habitat. Visibility is typically determined by first modeling a computerized representation of a vegetation-free landscape (a bare-earth digital elevation model [DEM]). Then, locations of straight-line, unobstructed visibility (lines-of-sight) between the lek and the potential development are calculated across that landscape. However, vegetation height, size and location can be accurately measured and incorporated into the model using a laser scanning technique known as light detection and ranging (LiDAR). Incorporating vegetation obstructions into modeled lines-of-sight between leks and potential development would better characterize visibility, and potentially increase usable area while maintaining sage-grouse habitat quality.

Objective:

This study aimed to determine the impact on visibility in sage-grouse habitat from 1) varying DEM type; 2) varying simulated development structure height; and 3) varying the LiDAR data density from which the DEMs are derived. The hypotheses were that 1) points viewed across DEMs that include vegetation and other above-ground obstructions (highest-hit DEMs) would be less visible than points at the same locations viewed across bare-earth DEMs 2) shorter structures would be less visible than taller ones; and 3) points viewed across DEMs derived from higher density LiDAR data would be less visible than points at the same locations viewed across DEMs derived from lower density LiDAR data, due to more accurate obstruction (shrub) modelling.

Benefit:

This study's primary military mission benefit is a demonstration of how to enlarge developable area without negatively impacting sage-grouse habitat through increased visibility. This has potential to reduce natural-resources-related encroachment on training and testing areas.

Summary of Approach:

Across southern Idaho, 3 study sites were chosen that had both documented sage-grouse leks and freely available high-density LiDAR data. Bare-earth and highest-hit DEMs created from the LiDAR datasets were used for visibility analyses. At each study site, visibility was calculated between 3 lek points and simulated structures of 2, 15, and 50 m, representing fences, electrical poles, and towers, respectively, at 100,000 random points across each type of DEM. Additionally, at one site, visibility calculations were compared between DEMs created from the LiDAR dataset before (11.73 points/m^2) or after thinning to 4.31 points/m^2.

Accomplishments:

The results of this study supported all hypotheses, although individual results among sites varied. Specific findings include:

- Using a highest-hit DEM instead of a bare-earth DEM reduced visibility in all cases. Non-trivial reductions occurred in 5 of the 9 original LiDAR data scenarios, with 23 - 47% fewer points visible viewed across a highest-hit instead of a bare-earth DEM.
- Shorter structures were less visible in every case tested. 15 m structures were visible at 21 - 54% fewer points than 50 m structures; 2 m structures were visible at 53 - 79% fewer points than 50 m structures.
- Both data density scenarios reduced structure vsibility, although reductions from using a highest-hit DEM instead of a bare-earth DEM were a mean 50% greater when using the higher density LiDAR data.

Using a highest-hit DEM instead of a bare-earth DEM is most likely to reduce visibility and increase land available for military activities when: the topography is flat or highly varied; the planned development is less than or equal to 15 m; and the DEMs are developed from LiDAR data of at least 4 points/m^2, although denser data is likely to be more effective. These parameters can guide future implementations of this method.

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